

Review of the Papuan millipede genus *Silvattia* Jeekel, 2009, with descriptions of three new species (Diplopoda: Polydesmida: Paradoxosomatidae: Eustrongylosomatini)

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Abstract: The oligotypic genus *Silvattia* Jeekel, 2009, which has hitherto been known to comprise only two species from New Guinea, is rediagnosed and shown to include further three species from Papua New Guinea: *Silvattia petarberoni* sp. nov., *S. perplexa* sp. nov. and *S. jeekeli* sp. nov. A key is given to all five species of the genus.

Keywords: Millipede, *Silvattia*, taxonomy, new species, key, New Guinea.

Introduction

The genus *Silvattia* Jeekel, 2009 has recently been proposed to incorporate two species: *S. horvathi* (Silvestri, 1899) (the type species), from Eriba, Astrolabe Bay, Madang Province, and Malu (incorrectly spelled as Matu, actually also being equal to Malu Ambunti or Male near Ambunti), East Sepik, both localities in Papua New Guinea, as well as *S. digulana* Jeekel, 2009, from Upper Digul, Papua Province, Indonesia (Jeekel 2009). The genus was assigned to the tribe Eustrongylosomatini and characterized by the paraterga being mostly missing, coupled with the gonopods showing the femorite strongly expanded into a dorsal serrulate lamella and also equipped with an apical transverse spine, while the solenophore being elongate, ribbon-like and carrying a small spine at midway.

Prompted by the discovery of a small material of *Silvattia* Jeekel in the collection of Diplopoda from Papua New Guinea, housed in the National Museum of Natural History, Sofia (NMNHS), we present here an amended diagnosis of the genus to incorporate three new species described below. In addition, a key is provided to all five species of *Silvattia* known to date.

This is our fifth joint publication dealing with millipedes from Papua New Guinea, based on the collections of Petar Beron taken in 1975 by the British Speleological Expedition (see also Golovatch and Stoev 2009, 2010, 2011, Golovatch et al.

2010). The expedition focused on the exploration of caves in the region of Telefomin and the neighbouring Finim Tel Plateau, Bahrman Range, situated north of the Hindenburg Wall. A detailed description of the region, its geological and climatic characteristics and the expedition's results can be found in Brook (1976). Nearly all type material is deposited in the collection of NMNHS, with only a single paratype donated to the Zoological Museum, Moscow State University, Russia (ZMUM), as indicated hereafter.

Taxonomical part

***Silvattia perplexa* sp. nov.** (Figs 1-8, plate 4, fig. 1)
Holotype ♂ NMNHS, **Papua New Guinea:** West Sepik Province, Telefomin area, 1700 m, September 1975, leg. P. Beron.

Derivatio nominis: To emphasize the particularly complex gonopod femorite and solenophore.

Diagnosis: The gonofemurite and solenophore of this new species are both remarkably complex as compared to all known Eustrongylosomatini.

Description: Length ca 21 mm, width of midbody pro- and metazona 1.5 and 1.9 mm, respectively. Coloration generally brown to dark brown; antennae dark brown, growing increasingly infusate towards antennomere 6; legs and sterna light brown; collum with a small median greyish spot in anterior third;



following segments with similar light grey bands extending from about ozopore level dorsally in front halves (Plate 4, fig. 1). Telson with a similar, but smaller spot mid-dorsally. In width, head = segments 2 and 3 > collum < 4 < 5 = 17, thereafter body gently tapering towards telson. Front half of head densely setose, caudal half bare. Antennae short, slightly clavate, reaching behind collum when stretched dorsally; antennomere 2 longest, slightly longer than 6th, the latter highest and only slightly longer than subequal antennomeres 3-5; antennomere 7 shortest. Paraterga nearly wanting on collum, small flaps, rounded both anteriorly and posteriorly, in segment 2, very small and rounded ridges delimited by a very faint sulcus only dorsally in segments 3-5; onwards until segment 19 faint, transverse, rounded bulges increasingly poorly developed towards telson (Fig. 1, plate 4, fig. 1). Ozopores small, but evident, lying laterally in caudal quarter of paraterga (Fig. 1). Tergal setae missing, setation pattern untraceable. Body slightly moniliform, transverse metatergal sulcus totally missing. Tegument smooth and shining. Stricture between pro- and metazona almost smooth, deep, only sometimes very faintly striolate. Pleurosternal carinae missing. Sternites densely setose, cross impression evident. Epiproct moderately emarginated, lateral pre-apical papillae very small (Fig. 2). Hypoproct subtrapeziform, caudal setae strongly separated, placed on minute knobs (Fig. 3). Sternal lobe between coxae 4 missing, with 2+2 bunches of setae instead (Fig. 4). Legs rather short and stout, about as long as midbody height, tarsal brushes absent only from last two leg-pairs. Gonopods highly complex (Figs 5-8). Coxa with a few setae distoventrally, rather short, much shorter than telopodite. Prefemoral part short, as usual, densely setose; femorite only slightly longer than solenophore, but strongly expanded, with a distinct sublateral arm (**k**) and several folds, distal part with two distinct spines: **a** longer and subflagelliform, **b** short, stout and dentiform. Subapical part of solenophore (**x**) tripartite, unusually complex.

***Silvattia petarberoni* sp. nov.** (Figs 9-14, plate 4, fig. 2)

Holotype ♂ NMNHS, **Papua New Guinea**: West Sepik Province, Telefomin, 1600 m, 2 August 1975, leg. P. Beron.

Derivatio nominis: Honours Petar Beron, the famous Bulgarian naturalist who collected all material treated in this paper.

Diagnosis: Differs from all species of this genus

in the absence of any outgrowths in the distal part of the gonofemorite and by the peculiar shape of the solenophore.

Description: Length ca 22 mm, width of midbody pro- and metazona 1.5 and 1.9 mm, respectively. All characters like in *S. perplexa* sp. nov., except as follows. Coloration generally dark brown with light greyish paraterga and a rather wide, oblong axial spot on all metaterga, including collum and telson (the latter without lateral spots). Antennae a little slenderer, reaching behind until midway of segment 2 when stretched dorsally; antennomere 6 longest and highest, slightly longer than subequal antennomeres 2-5 (Plate 4, fig. 2). In width, head = 5-17 > collum > 2-4, thereafter body gently tapering towards telson. Paraterga nearly wanting on collum, small flaps, rounded both anteriorly and posteriorly, in segment 2, very small and rounded ridges delimited by a very faint sulcus only dorsally in segments 3-4; onwards until segment 18 faint longitudinal bulges increasingly poorly developed towards telson (Fig. 9, plate 4, fig. 2). Axial line barely traceable. Legs longer and slenderer, about 1.3 times as long as midbody height, tarsal brushes gradually reduced towards legs of segment 14. Stricture between pro- and metazona faintly striate dorsally. Epiproct very poorly concave at tip, small lateral pre-apical papillae and similarly small dorsal papillae (Fig. 10). Hypoproct subtrapeziform (Fig. 11). Sternal lobe between coxae 4 very evident, linguiform, densely setose apically (Fig. 12). Gonopods much like in *S. perplexa* sp. nov., but far less strongly elaborate (Figs 13-14); femorite shorter than solenophore, strongly expanded, with two distinct lobes on mesal side (**l1** and **l2**); **l1** serrate, ventral, while **l2** smooth, larger and dorsal; distal part of femorite devoid of any outgrowths, solenophore subcircular, with a distinct ventral spine (**v**) and a dorsal lobe (**y**) near midway. Tip of solenophore a simple ribbon.

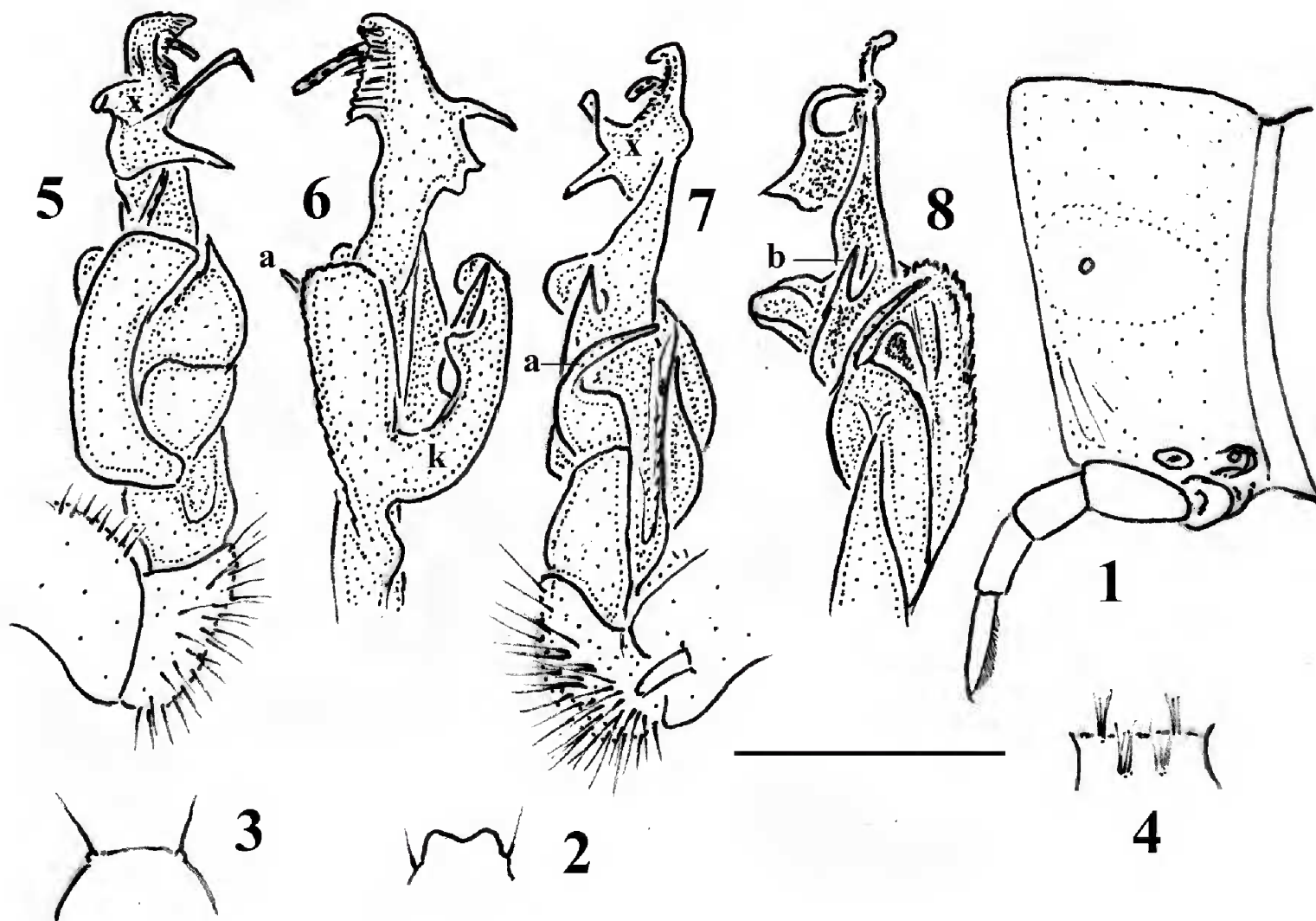
***Silvattia jeekeli* sp. nov.** (Figs 15-26, plate 4, figs 3-4)

Holotype ♂ NMNHS, **Papua New Guinea**: West Sepik Province, Tifalmin, 14.IX.1975, leg. P. Beron.

Paratypes 8 specimens: 2♂ & 1♀ NMNHS, 1♂ ZMUM, same locality, date and collector as in holotype; 1♂ NMNHS, Telefomin area, 1700 m, September, 1975, leg. P. Beron; 1♂ & 1♀ NMNHS, Chimbu Province, village of Goglme, Cave Ogon I, 1975, leg. P. Beron; 1♂ NMNHS, Western Province, Finim tel, 2300 m, 19 August 1975, leg. P. Beron.

Derivatio nominis: Honours the late Casimir Willem Jeekel, an outstanding specialist in diplopod





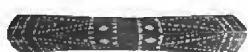
Figures 1-8. *Silvattia perplexa* sp. nov., holotype. 1 – Segment 10, lateral view; 2 – Tip of epiproct, dorsal view; 3 – Hypoproct, ventral view; 4 – Sternum between coxae 4, ventral view; 5-8 – Right gonopod, lateral, dorsal, mesal and subventral views, respectively [scale bar 1.0 mm (Figs 1-4) and 0.5 mm (Figs 5-8)].

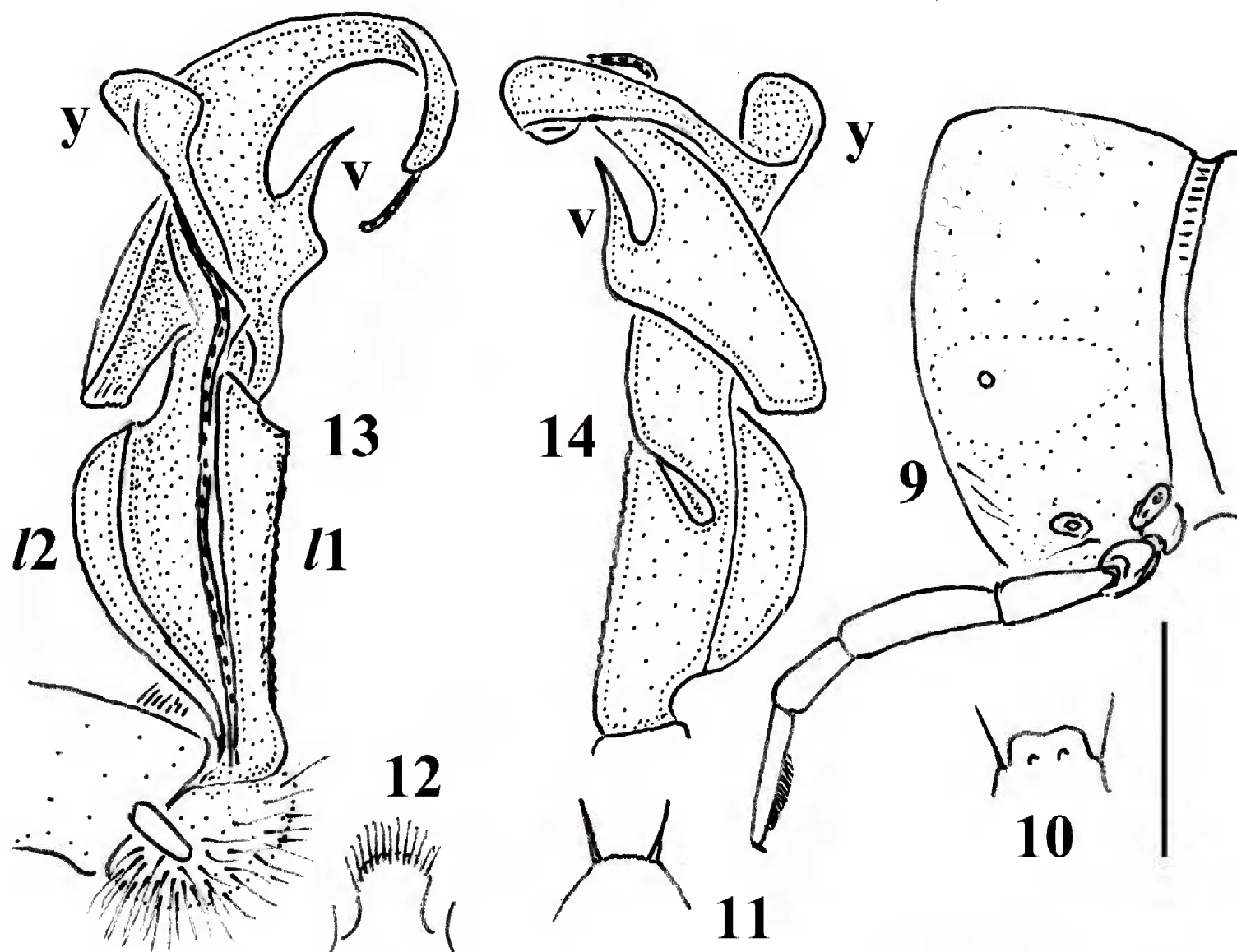
taxonomy.

Diagnosis: Differs from other congeners by the characteristic colour pattern, long legs, combined with the peculiar shapes of the relatively slender gonofemorite and the small distogonofemoral process, as well as by the peculiar shape of the solenophore.

Description: Length 23-26 (♂) or 25-28 mm (♀); width 1.7-2.0 and 2.0-2.5 mm (♂) or 2.4-2.7 and 2.8-3.0 mm (♀) of midbody pro- and metazona, respectively. Length of holotype ca 24 mm, width of midbody pro- and metazona 2.0 and 2.3 mm, respectively. All characters like in *S. perplexa* sp. nov., except as follows. Coloration blackish brown to brown with a vivid pattern (Plate 4, fig. 3); collum usually with a rather narrow, axial, horologiform, greyish spot running from front to caudal margin and merging frontally with a similarly narrow band along front margin and extending onto paraterga. Subsequent metaterga with a large, central, transverse, greyish band extending from near stricture to caudal edge, often extending down like a narrow ribbon to merge with similarly grey paraterga; epiproct also grey. In the paratype from

Finim tel, pattern slightly different (Plate 4, fig. 4): central spots on collum and subsequent metaterga taking up entire dorsal surface, but paraterga remaining dark. Legs and antennae blackish to dark brown. In width, head = collum = segment 3 < 4 < 2 = 5 = 17, or head = segment 5 = 16 > 2 > 3 > 4 > collum (♂♂); head < collum = segment 3 = 4 < 2 < 5 = 17 (♀♀). Antennae reaching behind segment 2 (♂♂) or collum (♀♀) when stretched dorsally; antennomere 6 longest and highest, sometimes subequal in length to antennomere 2 or to each of antennomeres 3-5. Paraterga poorly developed, but visible in segments 2 and 3(4) due to a dorsal sulcus, this also being barely traceable in segment 5; following paraterga increasingly poorly developed, longitudinal, rounded bulges until segment 17 or 18 (Figs 15, 21, plate 4, fig. 3). Epiproct deeply emarginated between apical papillae, subapical lateral papillae very small (Figs 16, 22). Hypoproct subtrapeziform (Fig. 17, 23). Stricture between pro- and metazona very finely striolate to smooth, sternal lobe between coxae 4 linguiform, densely setose apically (Figs 18, 24). Axial line barely traceable to absent. Legs either long and slender,





Figures 9-14. *Silvattia petarberoni* sp. nov., holotype. 9 – Segment 10, lateral view; 10 – Tip of epiproct, dorsal view; 11 – Hypoproct, ventral view; 12 – Sternal lobe between coxae 4, ventral view; 13-14 – Left gonopod, mesal and lateral views, respectively [scale bar 1.0 mm (Figs 9-12) and 0.5 mm (Figs 13-14)].

ca 1.3 times longer than midbody height (♂♂), or short and slender, 0.9 times longer than midbody height (♀♀). Gonopods showing slight variations in different structures (Figs 19-20, 25-26). Femorite rather slender (Figs 19-20, 25-26), about as long as solenophore, lateral face distinctly folded; lobe **l1** narrow, lobe **l2** not as strongly expanded as in other congeners; distofemoral process (**m**) short and slender; midway process (**z**) of solenophore slender and unciform. Tip of solenophore with a serrulate lobe (**n**).

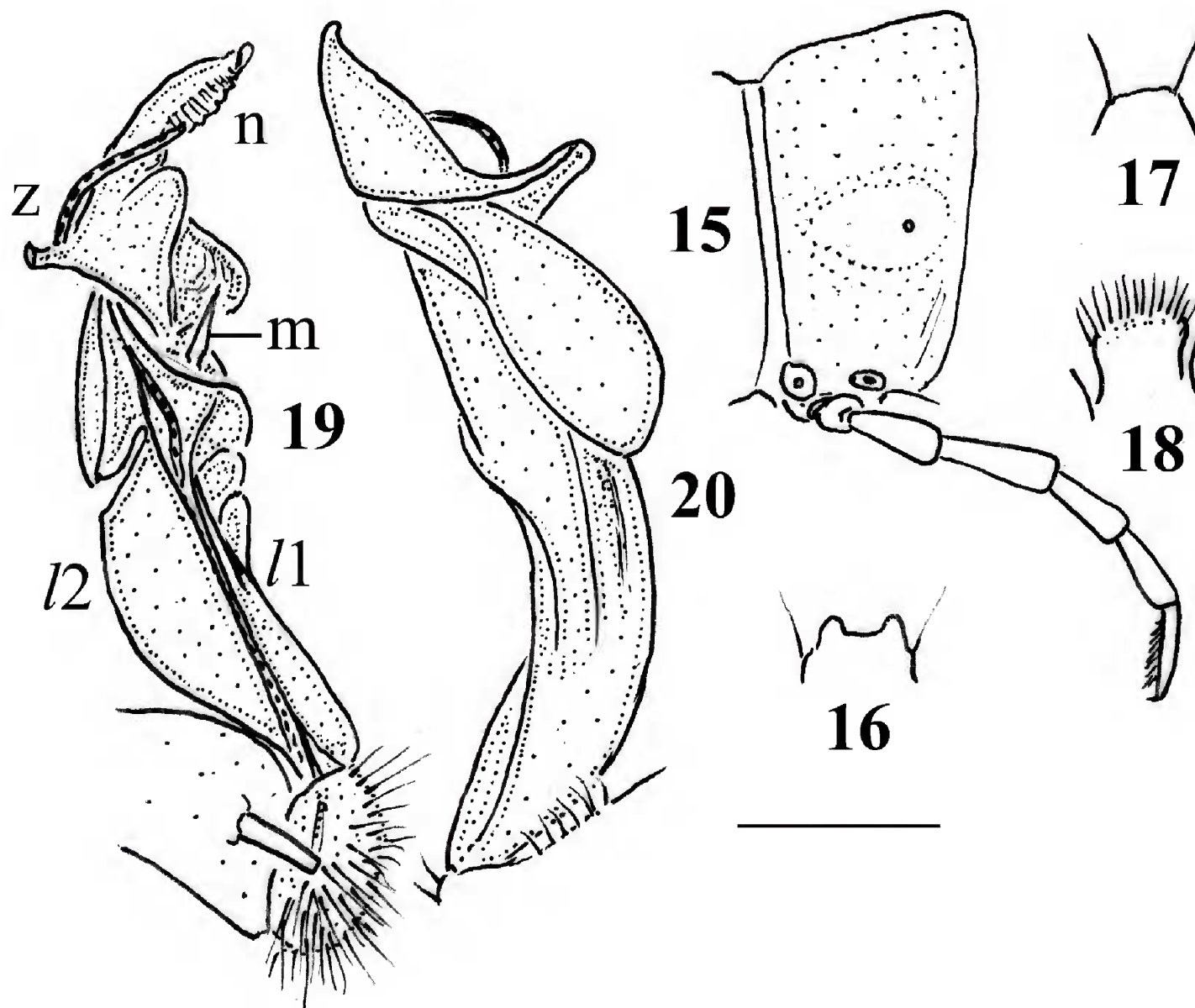
Position of *Silvattia* Jeekel, 2009 within Eustrongylosomatini

The tribe Eustrongylosomatini contains only a few genera (Jeekel 1968) which mainly occur in New Guinea and adjacent areas. Only one genus, the monobasic *Diglossosternoides* Golovatch, Korsós, 1992, is endemic to the Seychelles (Golovatch & Korsós 1992). The largest and most widespread

is *Eustrongylosoma* Silvestri, 1896, which contains more than 30 described and a number of undescribed species ranging from Borneo and the Philippines in the west, to Micronesia in the north, and to Melanesia and New Guinea in the east (Golovatch & Stoev 2011, 2013; Golovatch & Geoffroy 2013).

To properly incorporate the above three new species, several amendments to the diagnosis of *Silvattia* as quoted above appear to be necessary. For example, the presence of one or more distofemoral outgrowths on the gonopod is not obligatory, these structures being absent from *S. petarberoni* sp. nov. In this respect *Silvattia* fails to differ from *Eustrongylosoma*. Most of *Eustrongylosoma* species are devoid of distofemoral processes other than the usual apicolateral lobe, but a few show quite prominent distal processes, e.g. *E. exiguum* Hoffman, 1978, from Papua New Guinea, *E. kuekenthami* (Attems, 1897), from Borneo and Sulawesi, and *E. penevi* Golovatch, Stoev, 2013, from Luzon, Philippines (Hoffman 1978;





Figures 15-20. *Silvattia jeekeli* sp. nov., ♂ paratype from Telefomin. 15 – Segment 10, lateral view; 16 – Tip of epiproct, dorsal view; 17 – Hypoproct, ventral view; 18 – Sternal lobe between coxae 4, ventral view; 19-20 – Left gonopod, mesal and lateral views, respectively [scale bar 1.0 mm (Figs 15-18) and 0.45 mm (Figs 19-20)].

Golovatch 1997; Golovatch & Stoev 2013). A long distogonofemoral process is also characteristic of *Diglossosternoides*.

As regards the presence in the gonofemorite of a large dorsal serrulate lobe as quoted above, it can likewise be non-serrulate and rather modest, e.g., in *S. jeekeli* sp. nov. In this respect *Silvattia* again fails to differ from numerous *Eustrongylosoma* species.

The last gonopod trait quoted above concerns the presence in *Silvattia* of a midway process on the solenophore. This structure also appears too variable to be considered of generic importance. One or more processes are located in various places on the solenophore in all three new species. In addition, numerous *Eustrongylosoma* species have one or two similar structures on the solenophore (Golovatch & Stoev 2011).

The underdeveloped paraterga in *Silvattia* do not hold either, as the same condition is also observed, e.g., in *E. pallidum* Golovatch, Stoev, 2011, *E. prodelum* (Chamberlin, 1945) and *E. maculatum* Golovatch, Stoev, 2011 (Golovatch

& Stoev 2011). However, *Silvattia* does show several traits that define this genus against *Eustrongylosoma*, probably the closest among allies. Such is the relatively short, stout and elaborate gonopod femorite often, but not always, bearing a distal process, as well as again sometimes, but not always a particularly hypertrophied dorsal lobe. In addition, the solenophore in *Silvattia* carries at least two distinct outgrowths, being more elaborate than in *Eustrongylosoma*. The underdeveloped paraterga is still another character that defines the genus against most, but not all, species of *Eustrongylosoma*. We may soundly suggest that, due to a whole number of presumably derived conditions such as the paraterga strongly reduced and certain parts of the gonopod especially elaborate, *Silvattia* represents an evolutionary summit among the genera of Eustrongylosomatini.

A new diagnosis of *Silvattia* is thus necessary.

***Silvattia* Jeekel, 2009**

Diagnosis: A genus of Eustrongylosomatini



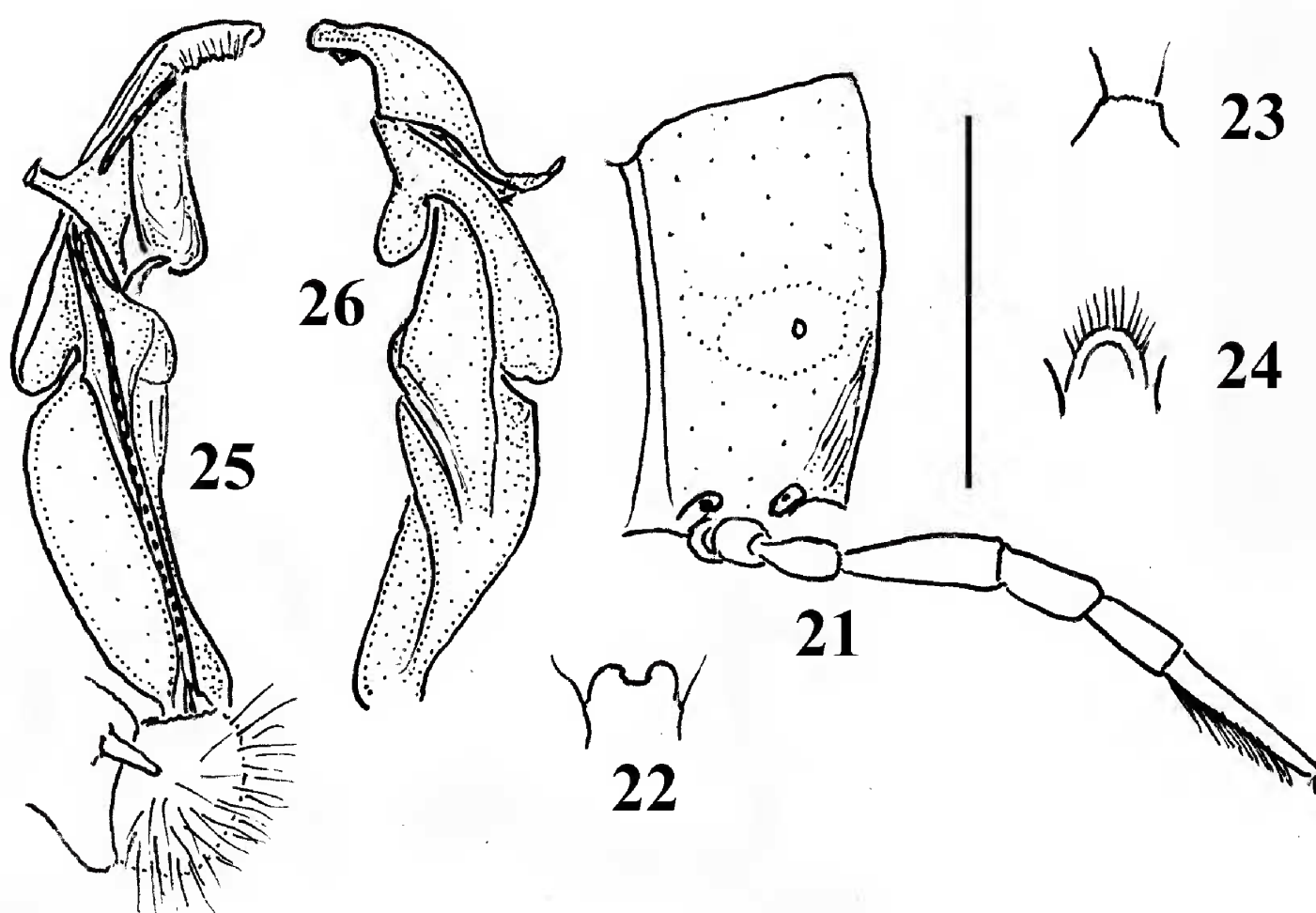
with 20 segments and a normal ozopore formula. Paraterga 6-17(18) longitudinal rounded bulges increasingly poorly developed towards telson. Gonopod femorite relatively short, stout and elaborate (about as long as solenophore), sometimes with a marked dorsal lobe and often with a distal process. Solenophore also elaborate,

suberect to subcircular, bearing at least two distinct processes in various places.

Type species: *S. horvathi* (Silvestri, 1899), by original designation.

Key to species of *Silvattia*

- 1 Size small, midbody metaterga 1.1-1.2 mm wide, transverse sulcus present in segments 5-18; gonopod with a distal femoral process directed transversely 2
 - Size larger, midbody metaterga at least 1.9 mm wide; transverse metatergal sulcus absent; gonopod with a distal femoral process directed distad 3
 2 Colour pattern: dark chestnut brown with a yellow to yellowish brown dorsal band in front of metatergal sulcus present only in posterior segments; distogonofemoral process rather short, solenophore elaborate only near tip
 *S. digulana*
 - Colour pattern: red-brown with a yellowish dorsal band in front of metatergal sulcus in all segments, segments 2-5 and 19 with a similar central spot also on prozona; distogonofemoral process long, about 0.5 times as long as femorite, solenophore with a midway process, tip less elaborate *S. horvathi*
 3 Sternal lobe between male coxae 4 missing, with 2+2 bunches of setae instead (Fig. 4); legs rather short and stout, about as long as midbody height (♂) (Fig. 1); gonopods highly complex (Figs 5-8), femorite with a distinct sublateral arm (k) *S. perplexa* sp. nov.
 - Sternal lobe between male coxae 4 present; legs longer and slenderer, about 1.3 times as long as midbody height (♂); gonopods less elaborate, sublateral arm on femorite absent (Figs 13, 25) 4
 4 Epiproct very poorly concave at tip (Fig. 10); gonopods as in Figs 13 and 14 *S. petarberoni* sp. nov.
 - Epiproct deeply emarginated between apical papillae (Figs 16, 22); gonopods as in Figs 19, 20, 25 and 26
 *S. jeekeli* sp. nov.



Figures 21-26. *Silvattia jeekeli* sp. nov., ♂ paratype from Cave Ogon I. 21 – Segment 10, lateral view; 22 – Tip of epiproct, dorsal view; 23 – Hypoproct, ventral view; 24 – Sternal lobe between coxae 4, ventral view; 25-26 – Left gonopod, mesal and lateral views, respectively [scale bar 1.0 mm (Figs 21-24) and 0.5 mm (Figs 25-26)].





Figure 27. Distribution of *Silvattia* species in New Guinea. 1 – *S. horvathi*; 2 – *S. digulana*; 3 – *S. petarberoni* sp. nov., *S. perplexa* sp. nov., *S. jeekeli* sp. nov.; 4 – *S. jeekeli* sp. nov.

Conclusions

The distribution pattern of *Silvattia* species in New Guinea seems to be rather sporadic, albeit all three new species occur sympatrically at least at Telefomin. In addition, four species seem to be confined to the western part of the island (Fig. 27). However, admitting so many lacunae existing in our knowledge of the Papuan millipede fauna, revealing many more congeners would be hardly surprising, including those in the eastern parts of New Guinea.

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We are most grateful to the Bulgarian - Russian Interacademician Exchange Programme which allowed the authors for brief research exchanges in 2012 to be made. Petar Beron (NMNHS) kindly provided certain important information concerning his 1975 trip to Papua New Guinea, while Dr. Dmitry Telnov (the Entomological Society of Latvia, Rīga) helpfully precised one of the relevant localities.

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Plate 4

GOLOVATCH, S.I., STOEV, P.: Review of the Papuan millipede genus *Silvattia* Jeekel, 2009, with descriptions ...



1



2



3



4

Figures 1-4. 1 – *Silvattia perplexa* sp. nov., holotype, habitus, lateral view; 2 – *Silvattia petarberoni* sp. nov., holotype, habitus, dorsolateral view; 3-4: *Silvattia jeekeli* sp. nov. 3 – Paratype ♂ from Tifalmin, habitus, lateral view; 4 – Paratype ♂ from Finim Tel Plateau, midbody segments, dorsal view.